EDM FINAL PROJECT REPORT – GROUP 5

STEP 1: Topic/Domain Selection

Topic: Design and Implementation of a Payroll Database System

Introduction:

In the contemporary business arena, effective human resource management is non-negotiable for sustained success. This report introduces an advanced Payroll Management System tailored to empower companies in precise employee compensation calculations. Beyond conventional payroll structures, our solution integrates allowances, deductions, and automated calculations. Designed with a focus on user-friendliness and adaptability, the system ensures seamless integration into diverse organizational structures. The Department table lays the foundation for organizational structure, while the Job Role table defines distinct positions within the workforce. Employees are seamlessly integrated, encompassing vital details such as name, gender, age, and affiliations with specific departments and roles. Each table is linked through foreign key relationships, ensuring data integrity and coherence. Additionally, the Allowance table enhances flexibility by accommodating various types of allowances for employees. The system further extends its capabilities through the Deduction tables, facilitating meticulous tracking of deductions linked to individual employees.

Advantages and Contributions:

The Payroll Management System revolutionizes payroll administration with its streamlined approach, offering a user-friendly interface for efficient data management. Administrators benefit from the dynamic configuration options, allowing personalized setups of allowances and deductions tailored to individual employee needs. The system's adaptability to diverse organizational structures ensures widespread applicability. The system's ability to calculate average ages by department, track allowances and deductions, and derive insightful analytics on fixed components within payrolls empowers businesses to make data-driven decisions. The integration of foreign key constraints ensures data integrity, while the

flexibility to customize queries allows for tailored analyses, contributing to enhanced payroll accuracy and strategic financial planning.

Uses Cases:

The applicability of the Payroll Management System transcends industry boundaries, making it a pivotal asset for organizations of varied scales and sectors. In the corporate realm, large enterprises benefit from their capacity to navigate complex structures, ensuring precise payroll management across diverse departments. Small and medium-sized businesses appreciate the system's scalability, offering tailored solutions to optimize resources and enhance financial transparency. Industries such as manufacturing, retail, healthcare, and technology leverage the system's efficiency in managing compensation intricacies specific to their workforce dynamics. Educational institutions find value in the transparent handling of academic and administrative payroll processes, while the hospitality sector seamlessly manages diverse allowances and working hour variations. Government entities and non-profit organizations utilize the system's capabilities for efficient, compliant, and accountable payroll administration. Global enterprises operating across diverse regulatory landscapes benefit from the system's adaptability and unified platform, providing a comprehensive solution for accurate and streamlined payroll processes. In essence, the Payroll Management System emerges as a versatile tool, meeting the nuanced needs of businesses and industries, fostering efficiency, accuracy, and compliance in payroll administration.

STEP 2: Conceptual Data Modelling & Database Design

Business Rules:

1.Department:

- Each department is uniquely identified by a Dept_Id.
- A department may have one or more job roles.

2.Job_Role:

- Each job role is uniquely identified by a Job_Role_Id.
- A job role may be associated with one or more employees.

3.Employee:

- Each employee is uniquely identified by an Emp_Id.
- An employee belongs to a single department and holds a specific job role within that department.
- An employee may have one or more deductions associated with their payroll.
- An employee may receive one or more allowances as part of their compensation.

4.Emp_Deduction:

- Each deduction is uniquely identified by an Emp_Deduction_Id.
- A deduction is associated with a specific employee.

5.Payroll:

- Each payroll is uniquely identified by a Payroll_Id.
- Payroll can have multiple payroll items.

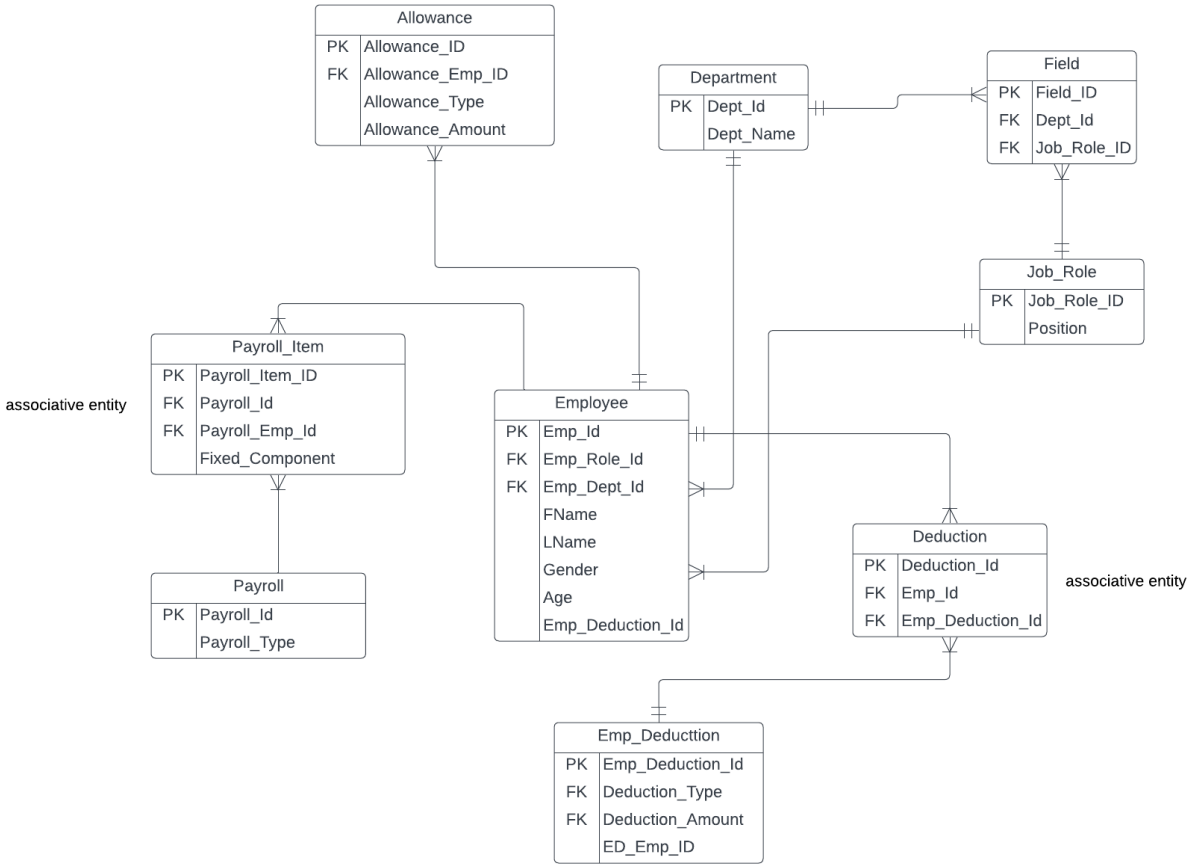
6.Payroll_Item:

- Each payroll item is uniquely identified by a Payroll_Item_ID.
- A payroll item is associated with a specific employee.

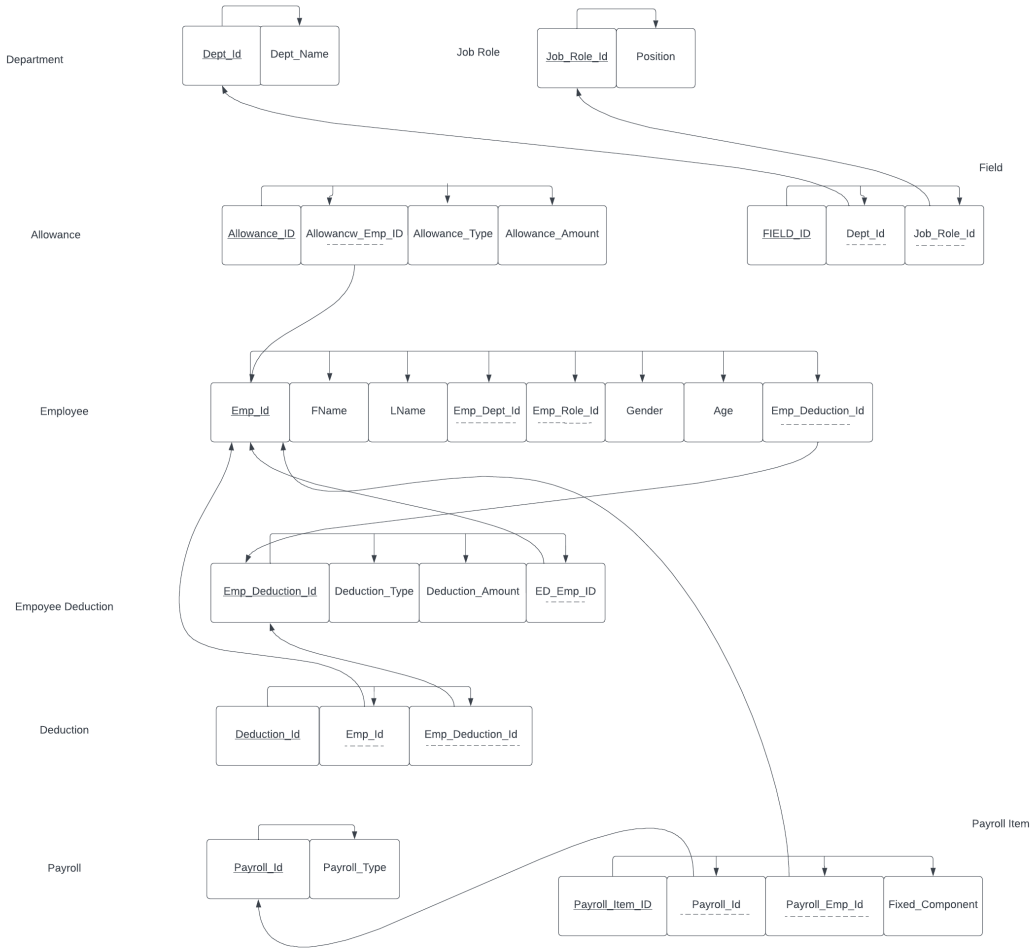
7.Allowance:

- Each allowance is uniquely identified by an Allowance_ID.
- An allowance is associated with a specific employee.

Conceptual Data Modeling: ER/EER Diagram:



ER/EER Model to Relational Model:



STEP 3: Database Implementation

SQL commands for creating tables for Database Implementation:

The SQL commands utilized in table creation for the database are provided below. The SQL commands for creating the database tables are also available in an attached text file named :

Create_MIS_Group5_EDM

```sql
CREATE TABLE `PayrollDB3`.`Department` (
  `Dept_Id` INT NOT NULL,
  `Dept_Name` VARCHAR(45) NULL,
  PRIMARY KEY (`Dept_Id`));

CREATE TABLE `PayrollDB3`.`Job_Role` (
  `Job_Role_Id` int NOT NULL,
  `Position` varchar(45) DEFAULT NULL,
  PRIMARY KEY (`Job_Role_Id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;

CREATE TABLE `PayrollDB3`.`FIELD` (
  `FIELD_ID` INT NOT NULL,
  `Dept_Id` INT NULL,
  `Job_Role_ID` INT NULL,
  PRIMARY KEY (`FIELD_ID`),
  INDEX `Dept_Id_idx` (`Dept_Id` ASC) VISIBLE,
  INDEX `Job_Role_Id_idx` (`Job_Role_ID` ASC) VISIBLE,
  CONSTRAINT `Dept_Id`
    FOREIGN KEY (`Dept_Id`)
    REFERENCES `PayrollDB3`.`Department` (`Dept_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `Job_Role_ID`
```

```
    FOREIGN KEY (`Job_Role_ID`)
    REFERENCES `PayrollDB3`.`Job_Role` (`Job_Role_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION);

CREATE TABLE `Employee` (
  `Emp_Id` int NOT NULL,
  `FName` varchar(45) DEFAULT NULL,
  `LName` varchar(45) DEFAULT NULL,
  `Emp_Dept_Id` int DEFAULT NULL,
  `Emp_Role_Id` int DEFAULT NULL,
  `Gender` varchar(45) DEFAULT NULL,
  `Age` int DEFAULT NULL,
  `Emp_Deduction_Id` int DEFAULT NULL,
  PRIMARY KEY (`Emp_Id`),
  KEY `Emp_Role_Id_idx` (`Emp_Role_Id`),
  KEY `Emp_Dept_Id_idx` (`Emp_Dept_Id`),
  KEY `Emp_Deduction_FK` (`Emp_Deduction_Id`),
  CONSTRAINT `Emp_Deduction_FK` FOREIGN KEY (`Emp_Deduction_Id`) REFERENCES `Emp_Deduction` (`Emp_Deduction_Id`),
  CONSTRAINT `Emp_Dept_Id` FOREIGN KEY (`Emp_Dept_Id`) REFERENCES `Department` (`Dept_Id`),
  CONSTRAINT `Emp_Role_Id` FOREIGN KEY (`Emp_Role_Id`) REFERENCES `Job_Role` (`Job_Role_Id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;

CREATE TABLE `Emp_Deduction` (
  `Emp_Deduction_Id` int NOT NULL,
  `Deduction_Type` varchar(50) DEFAULT NULL,
  `Deduction_Amount` decimal(10,2) DEFAULT NULL,
  `ED_Emp_ID` int DEFAULT NULL,
  PRIMARY KEY (`Emp_Deduction_Id`),
  KEY `ED_Emp_ID` (`ED_Emp_ID`),
  CONSTRAINT `ED_Emp_ID` FOREIGN KEY (`ED_Emp_ID`) REFERENCES `Employee` (`Emp_Id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;


CREATE TABLE `PayrollDB3`.`Deduction` (
  `Deduction_Id` INT NOT NULL,
  `Emp_Id` INT NULL,
  `Emp_Deduction_Id` INT NULL,
  PRIMARY KEY (`Deduction_Id`),
  INDEX `Emp_Id_idx` (`Emp_Id` ASC) VISIBLE,
  INDEX `Emp_Deduction_Id_idx` (`Emp_Deduction_Id` ASC) VISIBLE,
  CONSTRAINT `Emp_Id`
    FOREIGN KEY (`Emp_Id`)
    REFERENCES `PayrollDB3`.`Employee` (`Emp_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `Emp_Deduction_Id`
```

```
    FOREIGN KEY (`Emp_Deduction_Id`)
    REFERENCES `PayrollDB3`.`Emp_Deduction` (`Emp_Deduction_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION);

CREATE TABLE `PayrollDB3`.`Payroll` (
  `Payroll_Id` INT NOT NULL,
  `Payroll_Type` VARCHAR(45) NULL,
  PRIMARY KEY (`Payroll_Id`));

CREATE TABLE `PayrollDB3`.`Payroll_Item` (
  `Payroll_Item_ID` INT NOT NULL,
  `Payroll_Id` INT NULL,
  `Payroll_Emp_Id` INT NULL,
  `Fixed_Component` DECIMAL(10,2) NULL,
  PRIMARY KEY (`Payroll_Item_ID`),
  INDEX `Payroll_Id_idx` (`Payroll_Id` ASC) VISIBLE,
  INDEX `Emp_Id_idx` (`Payroll_Emp_Id` ASC) INVISIBLE,
  CONSTRAINT `Payroll_Id`
    FOREIGN KEY (`Payroll_Id`)
    REFERENCES `PayrollDB3`.`Payroll` (`Payroll_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `Payroll_Emp_Id`
```

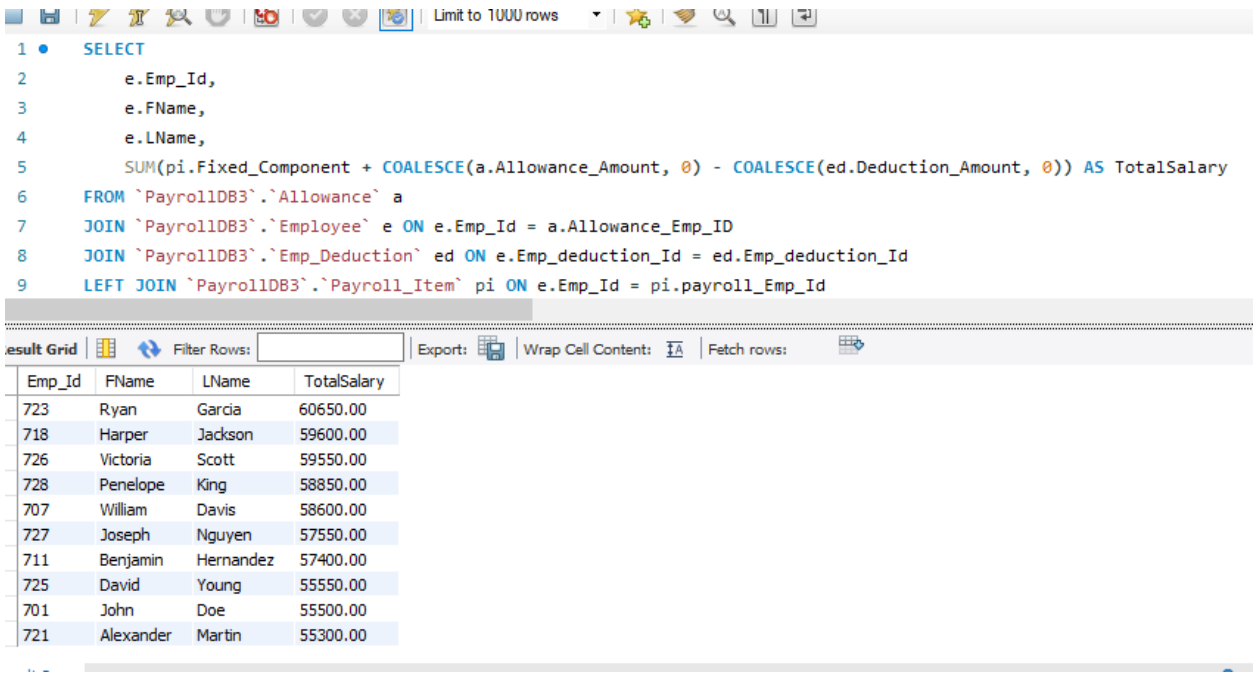
```sql
    REFERENCES `PayrollDB3`.`Payroll` (`Payroll_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION,
  CONSTRAINT `Payroll_Emp_Id`
    FOREIGN KEY (`Payroll_Emp_Id`)
    REFERENCES `PayrollDB3`.`Employee` (`Emp_Id`)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION);

CREATE TABLE `Allowance` (
  `Allowance_ID` int NOT NULL,
  `Allowance_Emp_ID` int DEFAULT NULL,
  `Allowance_Type` varchar(45) DEFAULT NULL,
  `Allowance_Amount` decimal(10,2) DEFAULT NULL,
  PRIMARY KEY (`Allowance_ID`),
  KEY `Allowance_Emp_Id_idx` (`Allowance_Emp_ID`),
  CONSTRAINT `Allowance_Emp_Id` FOREIGN KEY (`Allowance_Emp_ID`) REFERENCES `Employee` (`Emp_Id`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci;
```

SQL Commands to Insert Data into Database:

1. ***Top 10 Highest-Paid Employees:***

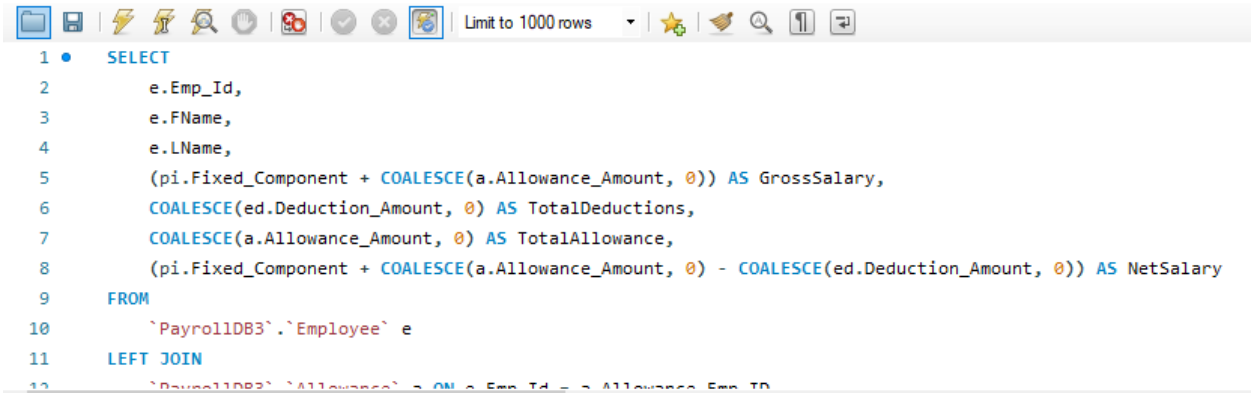
```
SELECT
   e.Emp_Id,
   e.FName,
   e.LName,
   SUM(pi.Fixed_Component + COALESCE(a.Allowance_Amount, 0) -
COALESCE(ed.Deduction_Amount, 0)) AS TotalSalary
FROM `PayrollDB3`.`Allowance` a
JOIN `PayrollDB3`.`Employee` e ON e.Emp_Id = a.Allowance_Emp_ID
JOIN `PayrollDB3`.`Emp_Deduction` ed ON e.Emp_deduction_Id = ed.Emp_deduction_Id
LEFT JOIN `PayrollDB3`.`Payroll_Item` pi ON e.Emp_Id = pi.payroll_Emp_Id
GROUP BY e.Emp_Id, e.FName, e.LName
ORDER BY TotalSalary DESC
LIMIT 10;
```



Emp_Id	FName	LName	TotalSalary
723	Ryan	Garcia	60650.00
718	Harper	Jackson	59600.00
726	Victoria	Scott	59550.00
728	Penelope	King	58850.00
707	William	Davis	58600.00
727	Joseph	Nguyen	57550.00
711	Benjamin	Hernandez	57400.00
725	David	Young	55550.00
701	John	Doe	55500.00
721	Alexander	Martin	55300.00

2. ***Top 5 Employees' Salary Components in PayrollDB3 Database***

```
SELECT
   e.Emp_Id,
   e.FName,
   e.LName,
   (pi.Fixed_Component + COALESCE(a.Allowance_Amount, 0)) AS GrossSalary,
   COALESCE(ed.Deduction_Amount, 0) AS TotalDeductions,
   COALESCE(a.Allowance_Amount, 0) AS TotalAllowance,
   (pi.Fixed_Component + COALESCE(a.Allowance_Amount, 0) -
COALESCE(ed.Deduction_Amount, 0)) AS NetSalary
FROM
   `PayrollDB3`.`Employee` e
LEFT JOIN
   `PayrollDB3`.`Allowance` a ON e.Emp_Id = a.Allowance_Emp_ID
LEFT JOIN
   `PayrollDB3`.`Emp_Deduction` ed ON e.Emp_Deduction_Id = ed.Emp_Deduction_Id
LEFT JOIN
   `PayrollDB3`.`Payroll_Item` pi ON e.Emp_Id = pi.Payroll_Emp_Id
ORDER BY
   NetSalary DESC
LIMIT 5;
```



Emp_Id	FName	LName	GrossSalary	TotalDeductions	TotalAllowance	NetSalary
723	Ryan	Garcia	62100.00	1450.00	2100.00	60650.00
718	Harper	Jackson	61200.00	1600.00	2200.00	59600.00
726	Victoria	Scott	61400.00	1850.00	2400.00	59550.00
728	Penelope	King	59600.00	750.00	1600.00	58850.00
707	William	Davis	60000.00	1400.00	2000.00	58600.00

3. ***Total Deduction Amount by Deduction Types***

```
SELECT Deduction_Type, SUM(Deduction_Amount) AS TotalDeduction
FROM `PayrollDB3`.`Emp_Deduction`
GROUP BY Deduction_Type
ORDER BY TotalDeduction DESC;
```

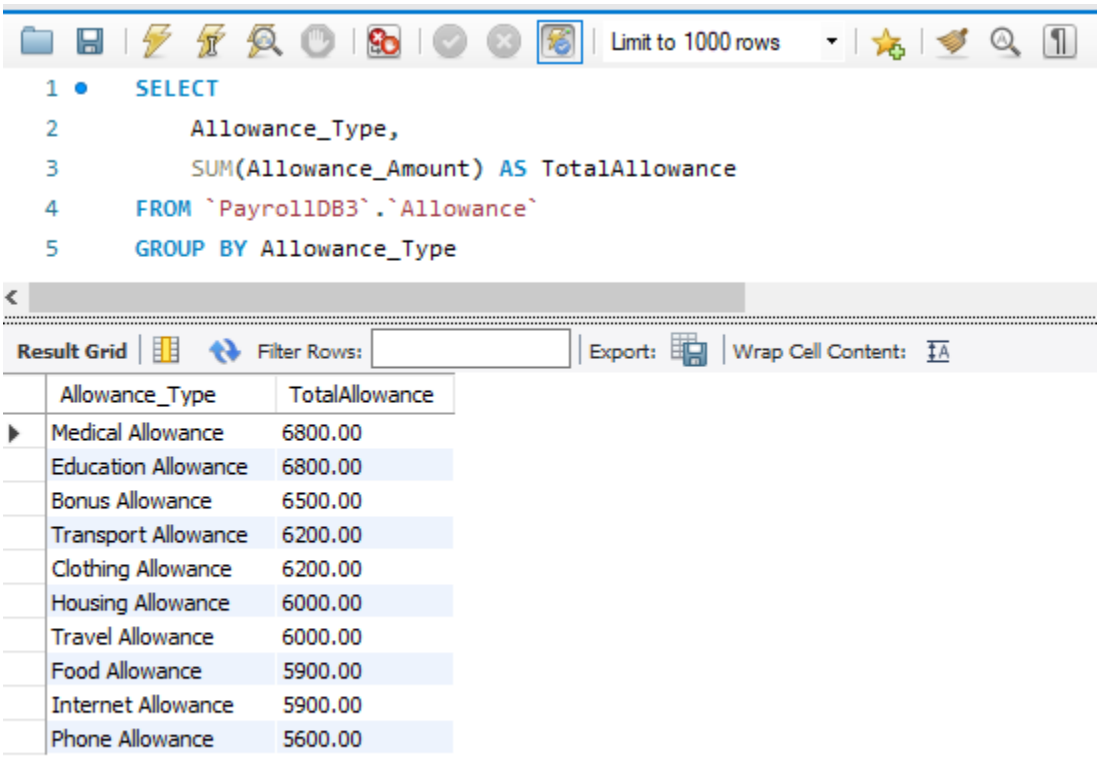
```
SELECT
    Deduction_Type,
    SUM(Deduction_Amount) AS TotalDeduction
FROM `PayrollDB3`.`Emp_Deduction`
GROUP BY Deduction_Type
ORDER BY TotalDeduction DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Deduction_Type	TotalDeduction
Savings Plan	22650.00
Health Insurance	6750.00
Retirement Fund	6100.00
Tax Deduction	4050.00

4. ***Total Allowance Amount by Allowance Types***

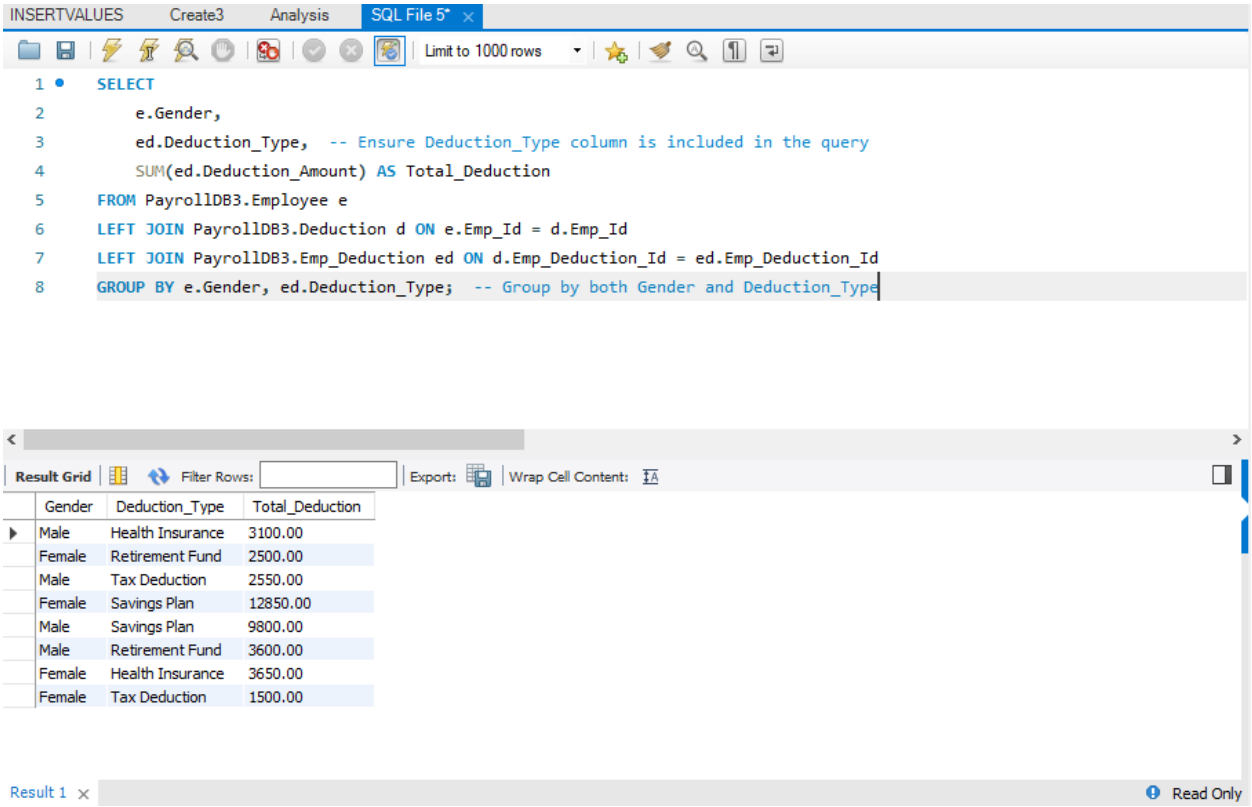
```
SELECT
   Allowance_Type,
   SUM(Allowance_Amount) AS TotalAllowance
FROM `PayrollDB3`.`Allowance`
GROUP BY Allowance_Type
ORDER BY TotalAllowance DESC;
```



Allowance_Type	TotalAllowance
Medical Allowance	6800.00
Education Allowance	6800.00
Bonus Allowance	6500.00
Transport Allowance	6200.00
Clothing Allowance	6200.00
Housing Allowance	6000.00
Travel Allowance	6000.00
Food Allowance	5900.00
Internet Allowance	5900.00
Phone Allowance	5600.00

5. ***Total Deduction by Deduction Type and Gender with Percentage Labels***

```
SELECT
   e.Gender,
   ed.Deduction_Type,  -- Ensure Deduction_Type column is included in the query
   SUM(ed.Deduction_Amount) AS Total_Deduction
FROM PayrollDB3.Employee e
LEFT JOIN PayrollDB3.Deduction d ON e.Emp_Id = d.Emp_Id
LEFT JOIN PayrollDB3.Emp_Deduction ed ON d.Emp_Deduction_Id = ed.Emp_Deduction_Id
GROUP BY e.Gender, ed.Deduction_Type;  -- Group by both Gender and Deduction_Type
```



Gender	Deduction_Type	Total_Deduction
Male	Health Insurance	3100.00
Female	Retirement Fund	2500.00
Male	Tax Deduction	2550.00
Female	Savings Plan	12850.00
Male	Savings Plan	9800.00
Male	Retirement Fund	3600.00
Female	Health Insurance	3650.00
Female	Tax Deduction	1500.00

6. ***Age Group-wise Deduction Summary***

```
SELECT
   Age_Group,
   Deduction_Type,
   SUM(Total_Deduction) AS Total_Deduction
FROM (
   SELECT
      CASE
         WHEN e.Age BETWEEN 20 AND 30 THEN '20-30'
         WHEN e.Age BETWEEN 31 AND 40 THEN '31-40'
         WHEN e.Age BETWEEN 41 AND 50 THEN '41-50'
         WHEN e.Age BETWEEN 51 AND 60 THEN '51-60'
         ELSE 'Other'
      END AS Age_Group,
      ed.Deduction_Type,
      SUM(ed.Deduction_Amount) AS Total_Deduction
   FROM PayrollDB3.Employee e
   LEFT JOIN PayrollDB3.Deduction d ON e.Emp_Id = d.Emp_Id
   LEFT JOIN PayrollDB3.Emp_Deduction ed ON d.Emp_Deduction_Id =
ed.Emp_Deduction_Id
   GROUP BY Age_Group, ed.Deduction_Type
) AS Deduction_Summary
GROUP BY Age_Group, Deduction_Type
ORDER BY Age_Group ASC, Total_Deduction DESC;
```

```
SELECT
    Age_Group,
    Deduction_Type,
    SUM(Total_Deduction) AS Total_Deduction
FROM (
    SELECT
        CASE
            WHEN e.Age BETWEEN 20 AND 30 THEN '20-30'
            WHEN e.Age BETWEEN 31 AND 40 THEN '31-40'
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Age_Group	Deduction_Type	Total_Deduction
20-30	Retirement Fund	2400.00
20-30	Tax Deduction	1500.00
31-40	Savings Plan	8100.00
31-40	Health Insurance	3200.00
31-40	Tax Deduction	2550.00
41-50	Savings Plan	8550.00
41-50	Health Insurance	2500.00
41-50	Retirement Fund	2000.00
51-60	Savings Plan	6000.00
51-60	Retirement Fund	1700.00
51-60	Health Insurance	1050.00

7. ***Comparison of Average Salaries Across Departments***

```
SELECT D.Dept_Name AS Department, AVG(PI.Fixed_Component) AS Avg_Salary
FROM `PayrollDB3`.`Employee` E
LEFT JOIN `PayrollDB3`.`Department` D ON E.Emp_Dept_Id = D.Dept_Id
LEFT JOIN `PayrollDB3`.`Payroll_Item` PI ON E.Emp_Id = PI.Payroll_Emp_Id
GROUP BY D.Dept_Name;
```

Limit to 1000 rows

```
1  SELECT D.Dept_Name AS Department, AVG(PI.Fixed_Component) AS Avg_Salary
2  FROM `PayrollDB3`.`Employee` E
3  LEFT JOIN `PayrollDB3`.`Department` D ON E.Emp_Dept_Id = D.Dept_Id
4  LEFT JOIN `PayrollDB3`.`Payroll_Item` PI ON E.Emp_Id = PI.Payroll_Emp_Id
5  GROUP BY D.Dept_Name;
```

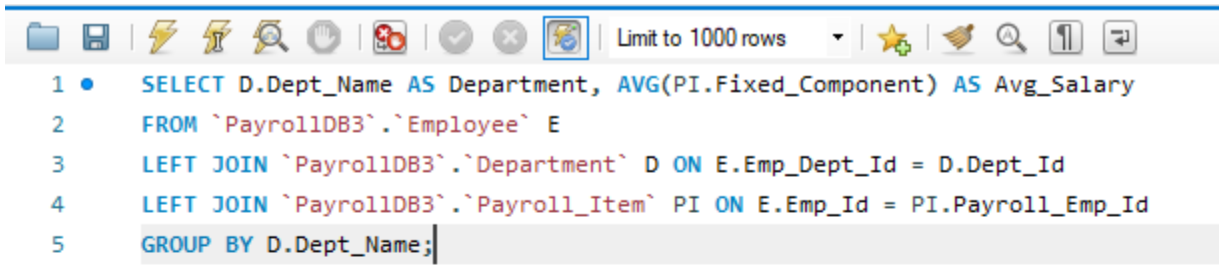
Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Department	Avg_Salary
Human Resources	55333.333333
Finance	43666.666667
Marketing	50666.666667
Information Technology	46666.666667
Operations	48666.666667
Sales	47333.333333
Customer Service	52333.333333
Research and Development	54000.000000
Administration	50333.333333
Legal	39000.000000

8. ***Department-wise Average Salary Deviation from Organizational Mean***

What is the average salary deviation from the organizational mean on a department-wise basis?

```
SELECT D.Dept_Name AS Department, AVG(PI.Fixed_Component) AS Avg_Salary
FROM `PayrollDB3`.`Employee` E
LEFT JOIN `PayrollDB3`.`Department` D ON E.Emp_Dept_Id = D.Dept_Id
LEFT JOIN `PayrollDB3`.`Payroll_Item` PI ON E.Emp_Id = PI.Payroll_Emp_Id
GROUP BY D.Dept_Name;
```



Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Department	Avg_Salary
Human Resources	55333.333333
Finance	43666.666667
Marketing	50666.666667
Information Technology	46666.666667
Operations	48666.666667
Sales	47333.333333
Customer Service	52333.333333
Research and Development	54000.000000
Administration	50333.333333
Legal	39000.000000

9. ***Employee Age Group Distribution Overview***

```
SELECT
  CASE
    WHEN Age BETWEEN 18 AND 25 THEN '18-25'
    WHEN Age BETWEEN 26 AND 35 THEN '26-35'
    WHEN Age BETWEEN 36 AND 45 THEN '36-45'
    WHEN Age BETWEEN 46 AND 55 THEN '46-55'
    ELSE 'Above 55'
  END AS Age_Group,
  COUNT(*) AS Employee_Count
FROM `PayrollDB3`.`Employee`
GROUP BY Age_Group;
```

Limit to 1000 rows

```
SELECT
    CASE
        WHEN Age BETWEEN 18 AND 25 THEN '18-25'
        WHEN Age BETWEEN 26 AND 35 THEN '26-35'
        WHEN Age BETWEEN 36 AND 45 THEN '36-45'
        WHEN Age BETWEEN 46 AND 55 THEN '46-55'
        ELSE 'Above 55'
    END AS Age_Group,
    COUNT(*) AS Employee_Count
FROM `PayrollDB3`.`Employee`
GROUP BY Age_Group;
```

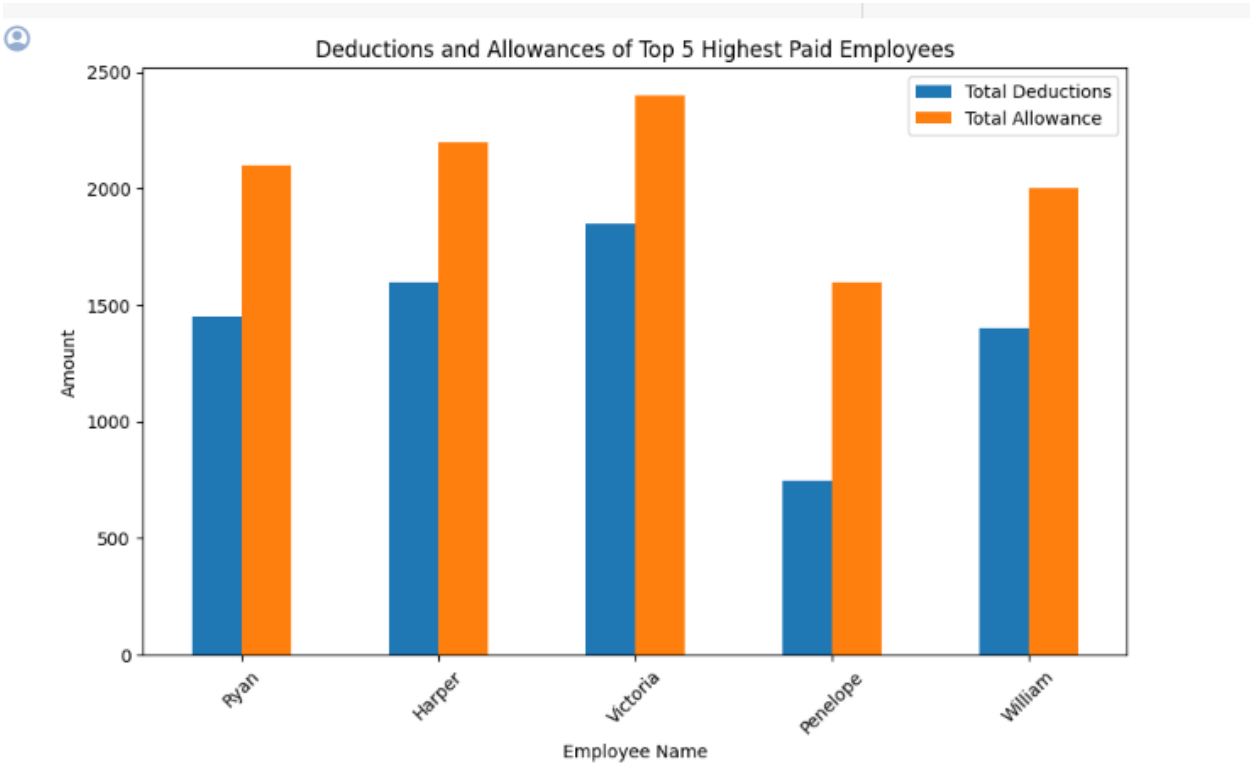
Result Grid | Filter Rows: | Export: | Wrap Cell Content:

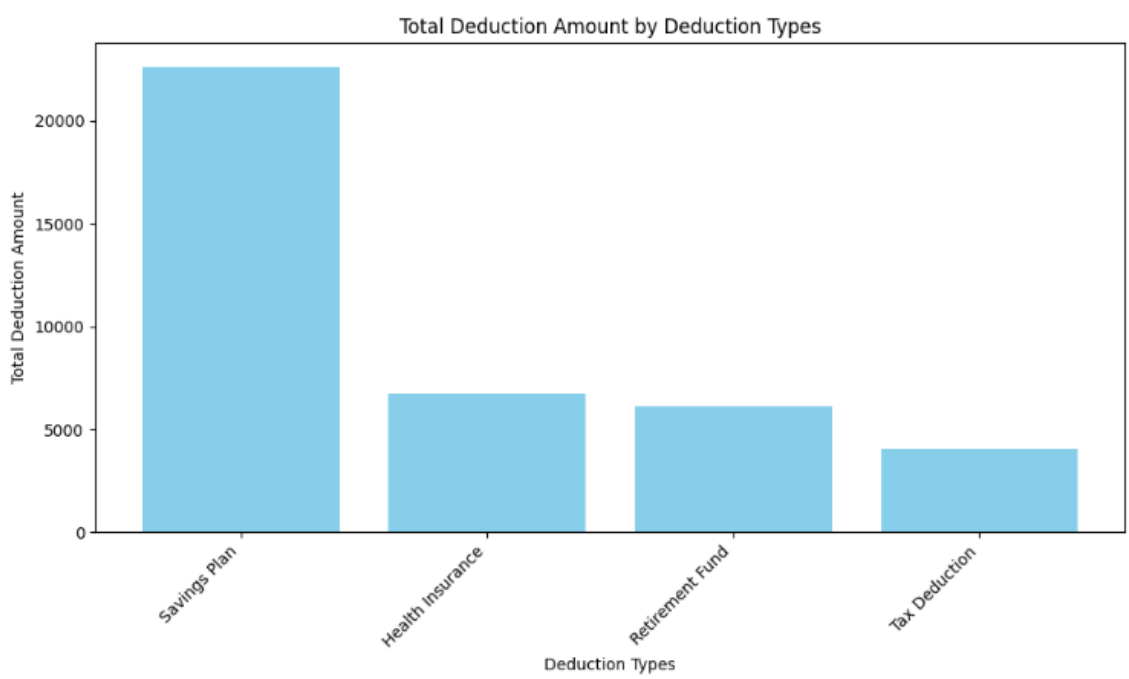
Age_Group	Employee_Count
26-35	8
36-45	10
46-55	11
Above 55	1

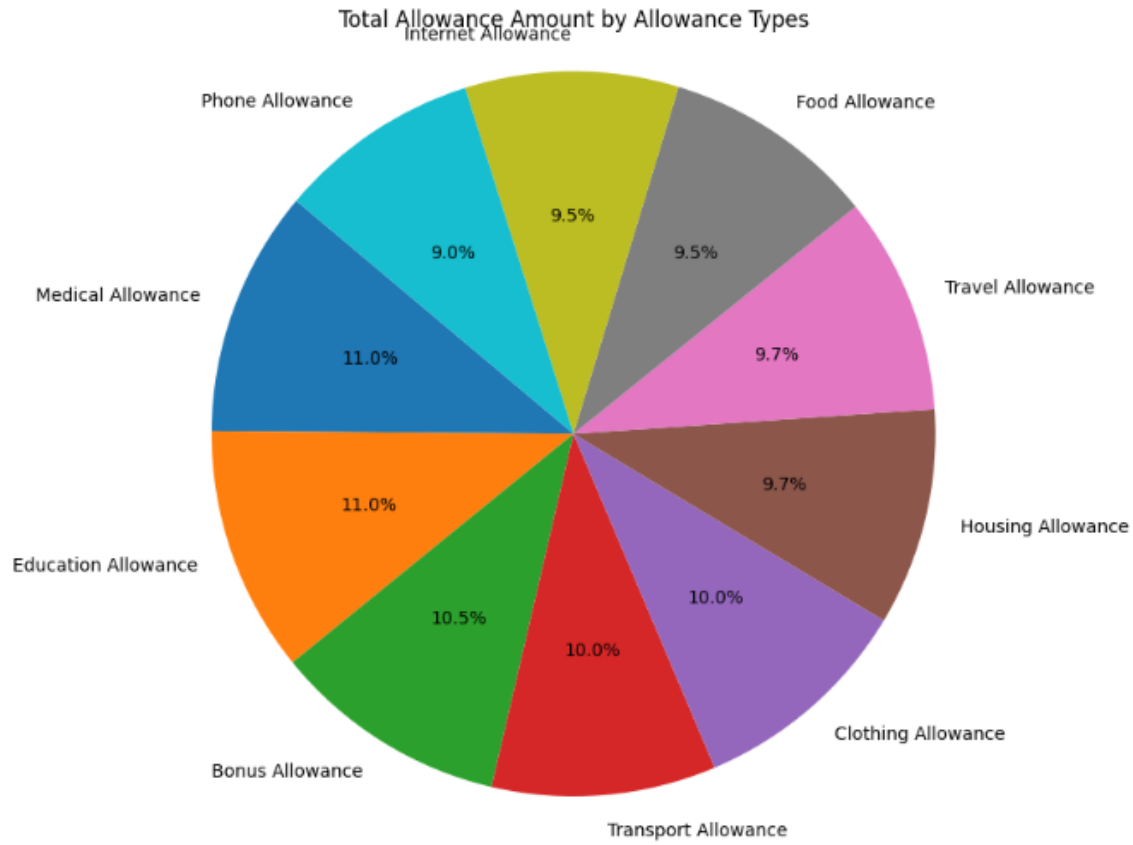
STEP 4: Enterprise (web) Database Dashboard:

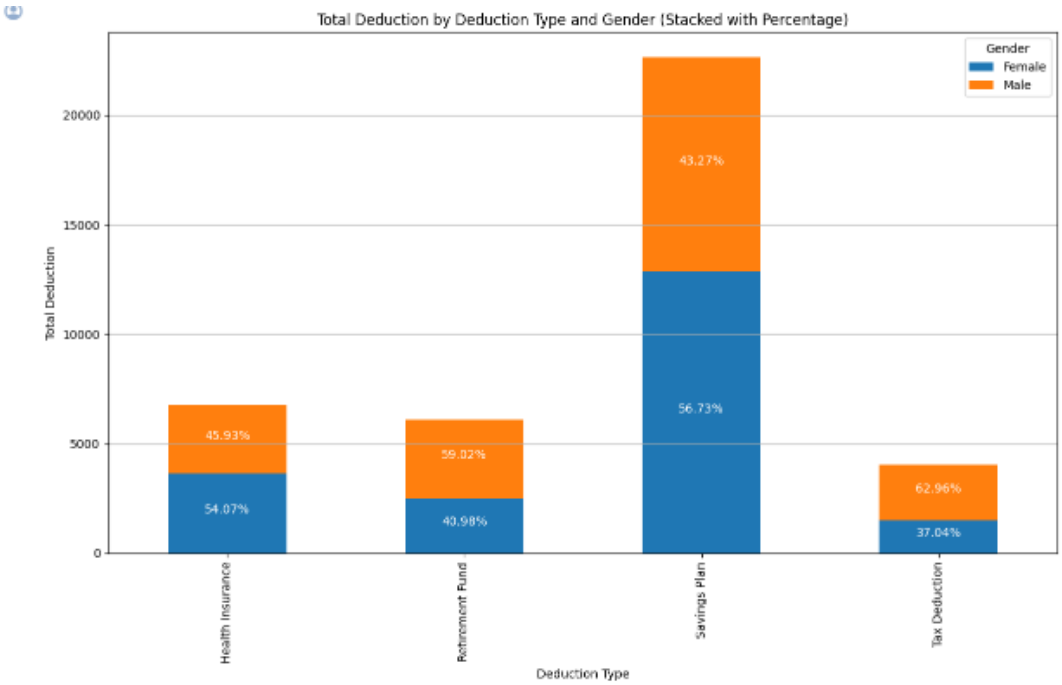
The analytical group dashboard can be found under the following link:

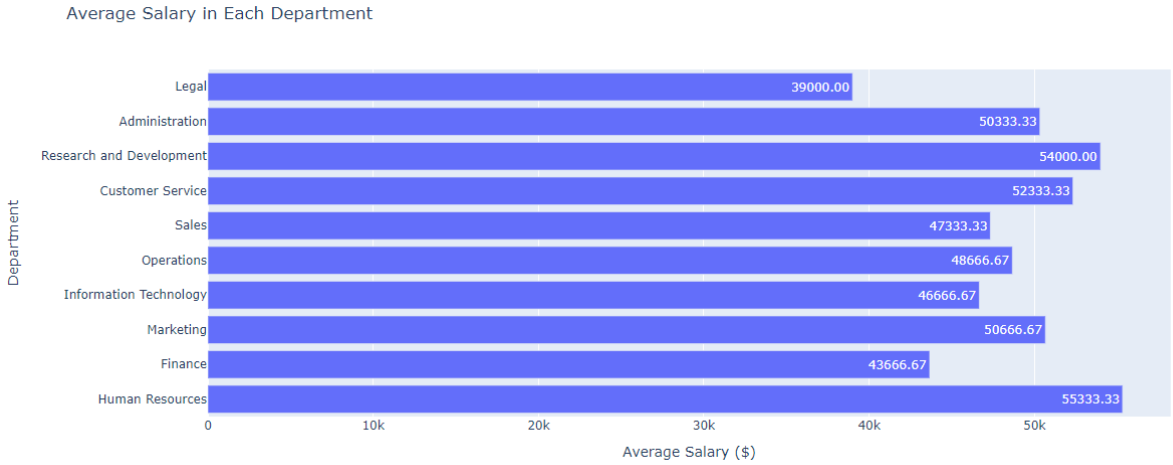
https://colab.research.google.com/drive/Group5



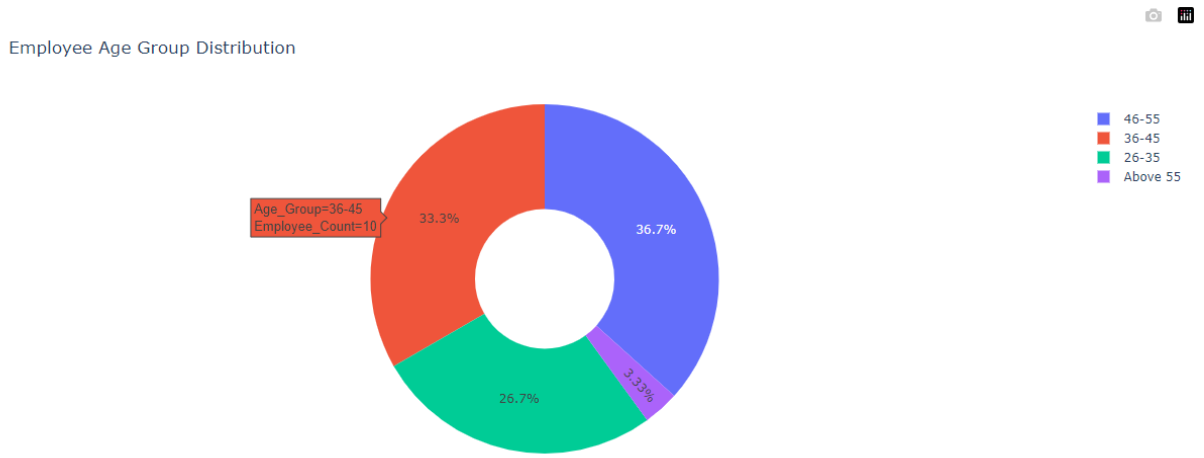

Total Deduction Amount by Deduction Types
Total Deduction Amount
20000
15000
10000
5000
0
Savings Plan
Health Insurance
Retirement Fund
Tax Deduction
Deduction Types


Total Allowance Amount by Allowance Types
Internet Allowance
Phone Allowance
Food Allowance
Medical Allowance
Travel Allowance
Education Allowance
Housing Allowance
Bonus Allowance
Clothing Allowance
Transport Allowance
9.5%
9.0%
9.5%
11.0%
9.7%
11.0%
9.7%
10.5%
10.0%
10.0%


Total Deduction by Deduction Type and Gender (Stacked with Percentage)
Gender
Female
Male
Total Deduction
0
5000
10000
15000
20000
45.93%
54.07%
59.02%
40.98%
43.27%
56.73%
62.96%
37.04%
Health Insurance
Retirement Fund
Savings Plan
Tax Deduction
Deduction Type


Average Salary in Each Department
Department
Legal
Administration
Research and Development
Customer Service
Sales
Operations
Information Technology
Marketing
Finance
Human Resources
39000.00
50333.33
54000.00
52333.33
47333.33
48666.67
46666.67
50666.67
43666.67
55333.33
0
10k
20k
30k
40k
50k
Average Salary ($)


Average Salary - Percentage Difference from Mean
Difference from Mean (%)
0.5M
0
−0.5M
−1M
Human Resources
Finance
Marketing
Information Technology
Operations
Sales
Customer Service
Research and Development
Administration
Legal
Department


Employee Age Group Distribution
Age_Group=36-45
Employee_Count=10
33.3%
36.7%
26.7%
3.3%
46-55
36-45
26-35
Above 55